

PDR RID Report

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Document

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RID ID	PDR	14
Review	FOS	
Originator Ref		CS004
Priority	1	

Section

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Figure Table

Category Name Design

Actionee HAIS

Sub Category

Subject How were the effective lines of code arrived at? What portion of the 298K is reused code? How is it allocated across the system? It is not clear how many lines of code are new code vs. reused code vs. code to adapt reused code.

Description of Problem or Suggestion:

- 1) It was not clear how many new lines of code are planned; how many lines of code are reused from other system vs. LOC reuse within ECS development; how many LOC are "recoding" of reused design; how much glue code, etc.
- 2) 298K vs. 600 K loc quoted.
- 3) Reused code has associated risk. Does the Risk Management Panel track this?

Originator's Recommendation

- 1) Prepare summary table to clarify points 1 and 2 under problem.
- 2) Hughes should prepare backup plan and potential impacts.
- 3) Prepare "metrics" to track "reuse".

GSFC Response by:

GSFC Response Date

HAIS Response by: D. Herring

HAIS Schedule 1/13/95

HAIS R. E. A. Miller

HAIS Response Date 1/31/95

Flight Operations Segment (FOS) Lines-of-Code

The FOS lines-of-code totals are included in Table 1. This table includes Total KLOC, New KLOC, Adapted KLOC, Internal Reuse KLOC, and External Reuse KLOC.

Table 1. Total Lines-of-Code

	Total	New	Adapted	Internal	Reuse
			External		
Current	639	131	253	167	88

Total - Estimated measure of the total LOC estimated for FOS

New - Estimated measure of the new software that needs to be developed for FOS. New software consists of brand new software that has been neither adapted nor reused from previous missions.

Adapted - Estimated measure of the software that will be adapted from heritage software or another control center project with very similar functional requirements. The adaptation pertains to adapting the design of the software from a previous project for a similar functional requirement to the FOS software. Adapted software can be developed very efficiently since it is based directly on a similar application for a previous mission, which has been fully integrated, tested, and used operationally.

Internal Reuse - Estimated measure of the software that will be reused within FOS; i.e., software that is developed for FOS that will be reused directly by FOS to perform similar functionality; e.g., IST functionality, such as telemetry decommutation processing, that was initially developed for the EOC. Internally reused software has been fully developed and tested within the EOC -- i.e., it is a subset of the Adapted and/or New software previously developed for use by the FOS.

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External Reuse - Estimated measure of the software that will be directly reused by FOS that was originally developed for a different project. The external software is used directly by the FOS without modification. Externally reused software has been fully integrated, tested, and used operationally in the previous mission.

FOS Lines-of-Code by Subsystem

Table 2 provides the FOS lines-of-code partitioned by subsystem. The definitions for each of the columns in this table are the same as those described above for Table 1. Note that the % of adapted and reused software are each 40% of FOS, while the remaining 20% is estimated to be new software.

Table 2. FOS Lines-of-Code by Subsystem

Subsystem	New	Adapted	Reuse	Total
Planning and Scheduling	20	80	70	170
Command Mgt	22	10	27	59
Command	23	10	12	45
Telemetry	18	30	31	79
Resource Mgt	11	31	24	66
Analysis	5	10	13	28
Data Mgt	12	52	44	108
User Interface	20	30	34	84
Total	131	253	255	639
%	20%	40%	40%	

Software that is adapted for the FOS comes from a variety of sources. The FOS Reuse Plan, which is included in section 9.7 of the FOS Design Specification, dated November 1994, provides specifics of software that will be adapted from a variety of control center missions including NASA missions and FOS heritage missions.

New - Software developed brand new by the FOS pertains to functionality that is unique to the FOS. Examples of this new functionality includes the interface to the ASTER ICC, the Solid State Recorder tool, management of IST connections to the EOC, receipt and analysis of EDOS CODAs, management of standing orders, and definition of algorithms by users for analysis purposes.

Adapted - NASA missions including TPOCC, GENSaa, and OASIS used for the AM-1 project I&T; FOS heritage systems such as NASA PORTS and GTAS, NOAA GIMTACS and PACS, and Hughes Mission Planning Systems; and commercial control centers including N-STAR and GlobalStar provide some of the control center missions that will contribute to the adaptation of the FOS software. Examples of functionality that will be adapted for use in the FOS includes telemetry decom, EU conversions, and limit checking; resource models, schedulers, and timelines within Planning and Scheduling; ground scripts and constraint checking within Command Management; database validation and generation; establishment of strings, configuration setup, and monitoring functions within Resource Management; screen management, telemetry displays, analysis requests, and procedure control by the User Interface.

Reuse - The projects listed above will also contribute to the FOS development project through direct reuse. For example, CLIPS, an expert system package developed at Johnson Space Center, is being used in the Decision Support System prototype effort, and is also a strong candidate to be reused by the FOS during development. TPOCC's Relational Telemetry Expression (TPE) provides another potential reuse candidate. UPS and FORMATS are strong candidates to be reused directly by the FOS for the NCC and the FDF interfaces, respectively. The Hubble Space Telescope will provide the event analyzer, while the directive processing software is a viable candidate for providing the directive language processing. In addition, the Hughes DELPHI planning and scheduling software will be directly reused by FOS.

Reuse Plan

The FOS Reuse Plan will be updated during the detailed design phase to incorporate any additions, modifications, or deletions. In addition, the candidates for reuse will be examined to determine if and how they will be specifically reused within FOS -- i.e., cost/benefit analysis is performed to determine if the incorporation of the reused software would be more efficient than adapting the software by the FOS development team. The approach for measuring the direct software reuse will be specified in this plan as well.

The FOS Reuse Plan will be closely coordinated with the NASA FOS team. The FOS team has taken risk mitigation steps pertaining to the use of reused software from other missions. In particular, the FOS team has integrated the reused software in each possible case with the FOS prototype software to validate the feasibility of the reused software in the FOS domain (e.g., CLIPS, DELPHI, event analyzer, directive language processing, FORMATS). This item is not currently being tracked by the Risk Management Panel.

FOS has rerun the lines-of-code count included in this RID response against the software development productivity model. The results validate that the FOS can be developed within the current cost and schedule.